MAR 2 1943

Gas Journal

LIGHT - HEAT - POWER - BY-PRODUCTS

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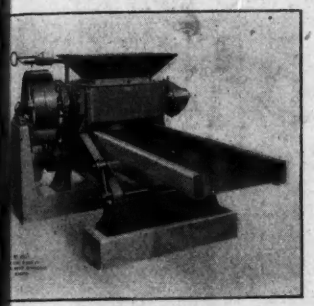
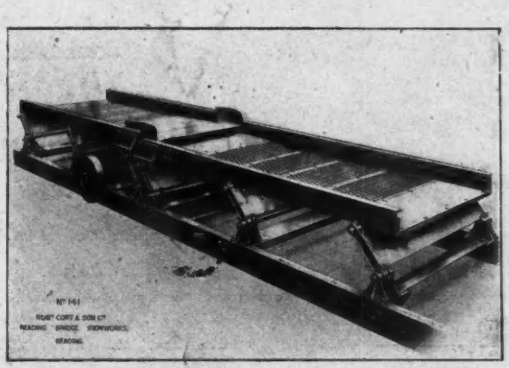
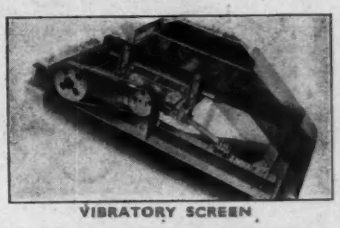


COKE CUTTING MACHINE WITH RECIPROCATING SCREEN

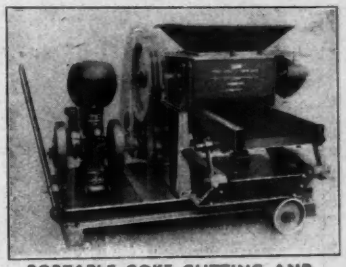


SCREENING CONVEYOR. 3 TO 75 TONS PER HOUR

RECIPROCATING DEBREEZING SCREEN



VIBRATORY SCREEN



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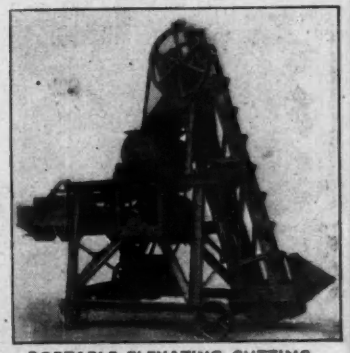

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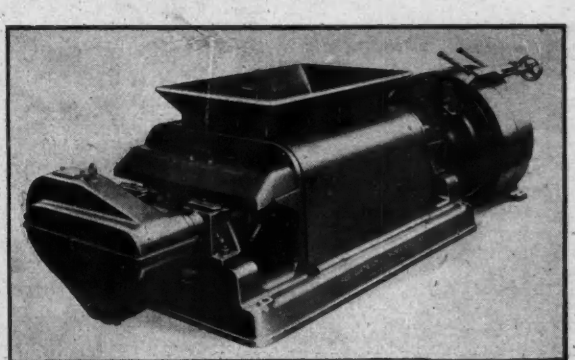

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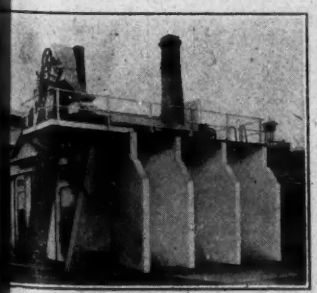
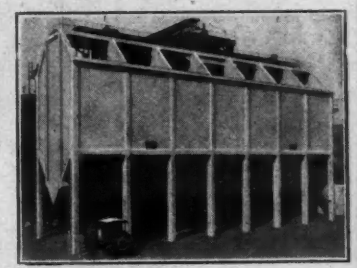


SUDBURY, SUFFOLK. 5 TONS PER HOUR



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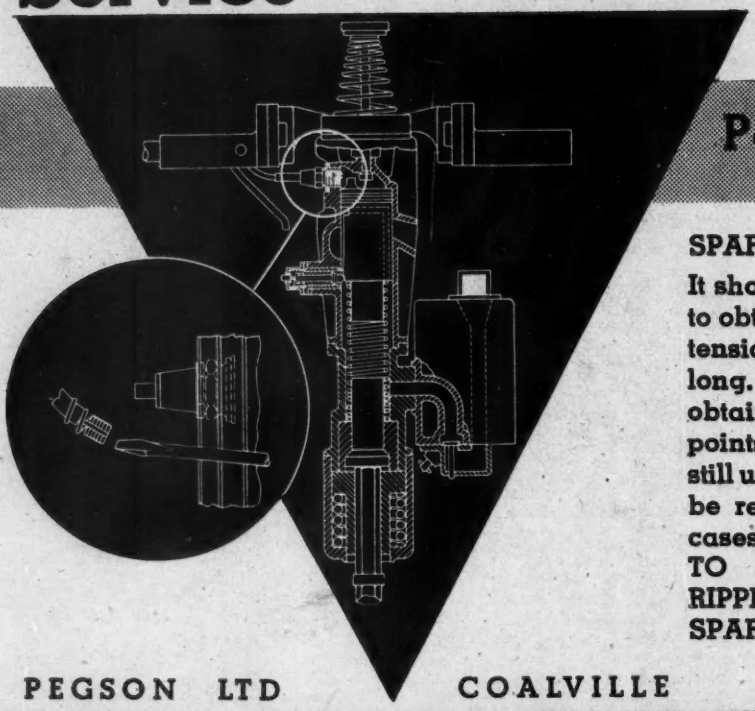

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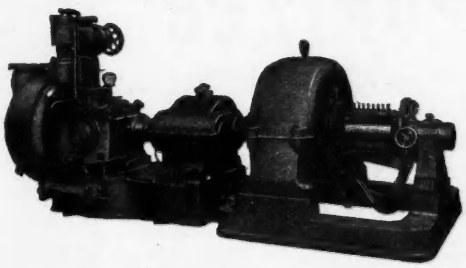

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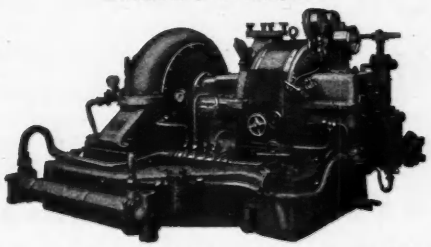

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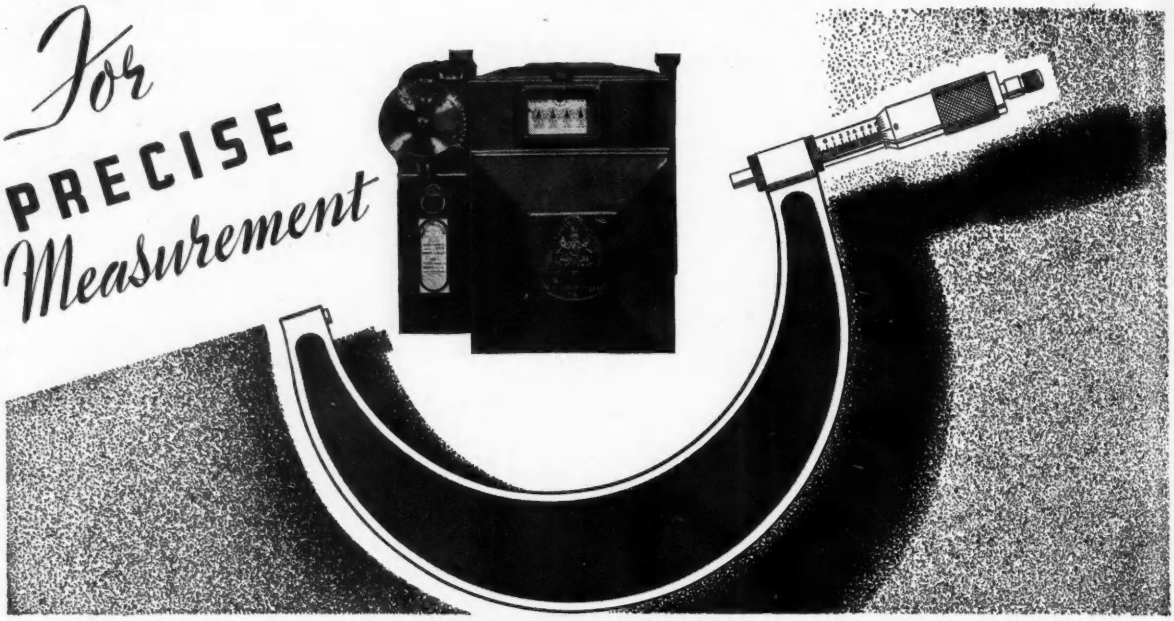

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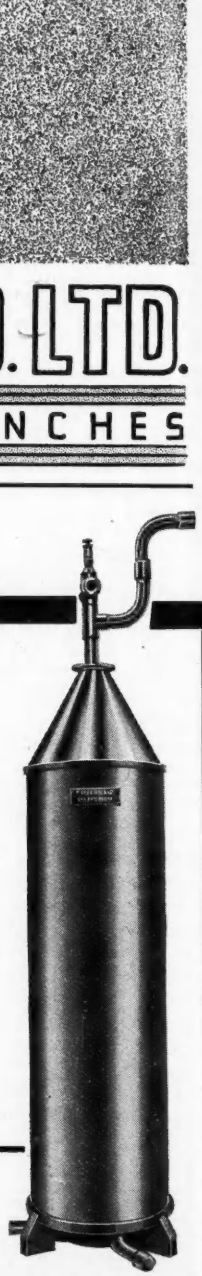

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GAS JOURNAL, JAN. 20, 1943

VOL. 241 95th YEAR No. 4157

EDITORIAL NOTES

FUEL CONSERVATION ON GAS-WORKS

IN our issue to-day we conclude publication of Dr. Pexton's Paper on the fuel requirements of carbonizing plants, which we have had no hesitation, in spite of paper restrictions, in giving in full. Our report of the discussion—appropriately a discussion of high standard—will follow next week.

We have already laid emphasis on the significance of the Paper and have commented on certain aspects of it. There are, however, a few further features which we think we ought to underline. In the early part of the contribution ("JOURNAL" of Jan. 6) the Author dealt with changes in design of continuous vertical retorts during the past twenty years, particularly as affecting fuel requirements, and the story is one of constant progress towards higher gasmaking efficiency—*i.e.*, towards reduction in the amount of coal needed to make gas. Between 1920 and 1930 waste heat recovery contributed an increase in efficiency, in round figures, from 54% to 62%. Between 1930 and 1940 improved retort setting design contributed an increase in efficiency from 62% to 64%. Present-day designs are dependent during daytime on the supply of steam from direct-fired boilers, which is of importance in the up-grading of coke breeze; and the figure of future gasmaking efficiency—the not distant future, by the way—is given as 70%. Following our comments on the "fuel usage" index in last week's "JOURNAL" the import of this will be appreciated; and we would call attention to Dr. Pexton's interesting statement that by the end of this year Gas Light and Coke Company's plant to the extent of 200,000 therms of gas per day will show a net saving of 7,500 tons of dry coke per 275 working days, account having been taken of the extra breeze now used in direct-fired boilers.

We would also call attention to that part of the Paper dealing with heat recuperation from the waste gases, the point to bear in mind, which is brought out clearly, being because of its smaller volume the secondary air has only half the heat capacity of the waste gases for an equal temperature. This means that with a perfect recuperation of infinite size it is only possible to cool the waste gases from, say, 900°C. to about 500°C. by pre-heating the secondary air to 900°C. In practice, recuperators may be of such a size that the air is pre-heated to about 700°C. by waste gases initially at 900°C. And it is shown (fig. 6, "JOURNAL" of Jan. 13) that a pre-heat of 0.26 therm in the secondary air is as effective as the supply of an additional 0.47 therm of producer gas to a non-recuperative setting. The reason is that the pre-heat in the secondary air does not involve any increase in volume of waste gases, and therefore is applied to the retort setting without a corresponding flue loss.

Turning to the important question of steaming, we have the deduction that in continuous vertical retorts the sensible heat in the coke between 1,000° and 850°C. amounts to 2 therms per ton of coal. This quantity of heat, it would appear, is capable of gasifying up to 60 lb. of carbon and so producing 3,860 cu.ft., or 12 therms, of water gas without incurring extra fuel consumption. This agrees with the generally accepted view of the Fuel Research Board and the Joint Investigation Committee that the first 5% steaming is very profitable, but that at higher degrees of steaming the water gas produced incurs at least as great a fuel expenditure per therm as does coal gas production.

Then we come to the Author's analysis of the fuel consumption of various carbonizing plants. A striking feature is the smaller amount of heat carried away by the crude coal gas and the coke leaving a continuous vertical retort compared with static carbonization. This is due to recovery of heat from the outgoing coal gas by incoming coal, and to the absorption of heat from the coke by steaming and by pre-heating the secondary air. This enables the continuous vertical retort to achieve almost as low a fuel consumption as the coke oven without any heat recuperation or regeneration from the waste gases. Since the waste gases from a continuous vertical retort setting can then be readily applied to steam raising, the performance of the continuous vertical retort is remarkably good. The Author adds that a comparable position can be attained by the coke oven with the adoption of dry cooling of the coke and recovery of the sensible heat in the form of high pressure steam.

Finally, we arrive at the Author's suggestions concerning directions in which further improvements in the efficiency of carbonizing units might be obtained. We referred to these in our "pre-view" of the Paper in the "JOURNAL" of Oct. 21 last, and we recount them to make this note—the purpose of which, as we have said, is to underline certain features of the contribution which appear to us as high-lights—complete. First of all, coke ovens. Here it is suggested that a useful line would be to consider pre-heating the primary air to the producers by heat exchange with the hot gases leaving the producers. Then, continuous vertical retorts. The overall fuel economy of this system is highly favourable, but the system "probably offers the greatest scope for further improvement." Some 30% of the fuel burnt is associated with the radiation and convection losses from the setting. This is not because of the greater intrinsic heat loss per unit of surface compared with other carbonizing plants, but because of the high proportion of heat carried away by the waste gases which is only permissible on account of the small net heat requirements with this system of retorts. More heat insulation would, Dr. Pexton states, be profitable. In addition, more cooling medium is required for further absorption of heat from the coke in the upper part of the extractor casing and the lower part of the retorts. Cooling of the coke by a further 200°C. would probably reduce the fuel consumption by 15%. The only additional cooling medium available is the primary air to the producers. The adoption of pre-heating the primary air would mean abandoning the use of water on the producer bars and the substitution of steam addition to the primary air, otherwise the pre-heat of the primary air would merely evaporate water. The simplest arrangement of applying primary air to the cooling of the bottom of the retorts would probably be to reserve the producer side retorts for this purpose and to apply secondary air cooling to the non-producer side retorts. All retort castings, &c., would then receive double the cooling medium compared with the present practice of using secondary air only.

With intermittent vertical retorts the Author expresses the opinion that considerable alteration in design would be required to effect substantial economy in fuel, and he suggests that the only method available would be an extension of the recuperator with the use of both primary and secondary air for cooling the waste gases. But in this way about 14% of the fuel might be saved. With horizontal retorts the same lines as for intermittent retorts can be followed, and greater insulation of the settings is worthy of consideration.

MORE ABOUT PLANNING

WE should hesitate to say offhand how many societies, organizations, and bodies of one kind and another are busily engaged in planning for the brave new world ahead. There are many of them, and some of them work outside the limelight, preferring to hide their light, at any rate for the time being, behind a bushel. We are, however, fully satisfied that the Gas Industry knows of their activities, follows their work

closely, and, where desirable and where assistance is sought, collaborates to good purpose.

What makes us return to this subject of planning is the receipt of Broadsheet No. 11 of the Association for Planning and Regional Reconstruction, which, dealing with coal utilization in Great Britain, obviously affects the Gas Industry—and it does in fact discuss the Industry's place in the general picture of energy production and use in quite a knowledgeable way. Before mentioning one or two of the conclusions set out in the Broadsheet from an analysis of relevant statistics we ought perhaps to explain something about this particular Association, the activities of which cover a most extensive field, ranging from social disorders such as drunkenness and suicide to the collection and disposal of human wastes. The Association was incorporated in 1940 as a company limited by guarantee and formed not for the purpose of profit; its object is to serve as a centre for research, to advise and suggest, to correlate experience, but not to compete with institutions or organizations operating in any specific fields of activity. It is financed by donation, by payment from individuals, firms, and organizations, and by grants from professional institutions and the like. It is a technical planning group concerned with the establishment of technical and other standards; it has a few full-time and part-time research workers and voluntary workers in many professions. Lord Forrester is the Chairman of the Board, and it may be recorded that the directors receive no remuneration for their services.

So to Broadsheet No. 11 of the Association, which starts off by illustrating the changes, since 1870, in the distribution of coal in Great Britain—the total amount used and the estimated amount of energy obtained. It finds that of the 70% or so of energy wasted, nearly half is due to the loss in flue gases, and that, in turn, one-third of this represents domestic chimney gases; it maintains that by established methods the efficiency of coal utilization could be raised from round about 25% to 40% (assuming a constant output of useful energy this would represent a saving of over 60 million tons of coal a year), and states that the Gas Industry comes last in the list of those responsible for the waste of coal energy. In saying which, by the way, it urges economy in the use of coke at gas-works—a subject foremost in the Industry's mind to-day. It is also suggested that the gas turbine may become important, and attention is rightly drawn to "background" heating.

Without going into any considerable detail, we might mention one or two of the interesting figures set out. Average consumption of useful energy is estimated at 120 therms per head, representing 300 to 350 therms as purchased. Maximum demand in the absence of financial and supply difficulties is estimated to be 80–250 therms for space heating, 100 therms for water heating, 15 therms for cooking—500–1,000 therms gross, which seems reasonable enough, and does point to the desirability, among other matters, of constructing new buildings so that they conserve heat. And it is remarked that the capital cost of electrical power stations, per unit of energy output, is nearly ten times that of gas and coke works. It adduces that the minimum cost of electricity production, excluding labour charges, is about 0.3d. per kw.h., and that of gas and coke 1½d. per therm. This means a ratio of 6 to 1 respectively for equivalent amounts of energy.

The foregoing will, we think, serve as indication of the type of information put forward in this four-page Broadsheet, prominent among the conclusions of which is the need in the future for carbonization of coal, with by-product recovery, whenever possible before combustion.

The Paint Industry

The scheme for the compulsory concentration of the paint manufacturing industry has been abandoned by the Government, but details of a modified scheme are being worked out by the Board of Trade and the Ministries of Supply and Labour in consultation with the industry. As reported in the "JOURNAL" of Dec. 9, Mr. C. R. Averill took a leading part in the campaign to prevent the closing down of many of the smaller manufacturers.

Personal

To mark the fiftieth anniversary of his entering the firm, Mr. JAMES FRANCIS DAVIES, Chairman of John Wright & Co., Ltd., and of Arden Hill & Co., Ltd., has been presented with an illuminated address bearing the signatures of all employees of long service. A presentation from the Directors of Radiation Ltd. (of which he is also Chairman) and the Associated Companies has also been made. Messages, including many from abroad, have paid tribute to the high regard and affection in which Mr. Davies is held by his friends in the Gas Industry.

* * *

Mr. HARRY JOHN HODDER, Assistant Engineer to the Hampton Court Gas Company, has been appointed Works Manager.

Obituary

The death of Sir HENRY MAYBURY will have recalled to many of the older generation of gas engineers his early work in our Industry. About 45 years ago he was in charge of the Gas Undertaking at Blaenau-Festiniog, going from there to Malvern. It was at Malvern that he developed his ideas for making use of coal tar in road making and repairing, which a few years later resulted in his leaving the Gas Industry for the Kent County Council, except for interests he kept up with some smaller undertakings at Winchcombe, Naseby, Bidford-on-Avon, &c.

Letter to the Editor

Ammonia and District Gas

DEAR SIR,—It occurs to me that I might with advantage draw the attention of your technical readers to the importance of ensuring that ammonia is not present in the gas supplied to the district.

Greatly to my surprise we found some time ago that this dreadful impurity was present in damaging quantity in the district gas at two of the works in our Group. In both cases its evil effects were noticeable on meters and the brass parts of appliances. At once we set about repairing a fault which should never have occurred, particularly in our Group, where we have travelling chemists always moving from works to works. This was due to a misplaced confidence that an impurity so easily removed would surely be absent in the district gas, and that the local management would certainly have made sure that no ammonia was present.

However, in both cases the local management and the travelling chemist were relying on each other, with the result stated above.

My letter is intended to be a warning to managers to make sure at all times that there is no ammonia in the gas supplied to the district. If the condensing, washing, and scrubbing plant are defective or too small, tar and ammonia can readily be excessive in quantity in the gas entering the purifiers. This is likely to be the case with those of us who are having to contend with increases of 50% or more in the gas sent out, as was the case in the two works in question.

The purifying plant will remove both for a time, but before long ammonia will become noticeable in the gas leaving the purifiers, by which time the problem will have become one of major importance, requiring strenuous measures. When the oxide becomes impregnated with ammonia the gas will continue to be supplied to the town with damaging quantities of ammonia, unless suitable methods are employed, for a long time after the washing and scrubbing plant has again been put in good condition.

During the last War serious and almost irreparable damage was done in many districts due to the supply of corrosive and badly purified gas. It is important, therefore, that great care should be taken to prevent the same thing happening again.

The Gas-Works, Cheltenham. Jan. 15, 1943.

Yours faithfully, G. M. GILL.

A Brochure of a most helpful technical nature has been prepared by the Whessoe Foundry and Engineering Company, Ltd., dealing with the design of condensers and coolers. It illustrates the Company's wide experience of gas-cooling problems, with special reference to their standardized designs of condenser and cooler for the treatment of fuel gases, and is an excellent example of the modern scientific treatment of the subject, and the enlightened attitude of gas contracting firms in placing their technical knowledge at the disposal of those in charge of gas-works plant.

Owing to current restrictions regarding such publications the firm is unable to distribute copies except on application; but copies are available, without charge, on request to the Technical Department of the firm, at Darlington.

FUEL REQUIREMENTS OF CARBONIZING PLANT*

By

S. PEXTON, Ph.D.,

Gas Light and Coke Company

(*Concluded from p. 63*)

(b) *Coke.*

Coke is discharged from horizontal retorts, intermittent vertical retorts and coke ovens at about 1,000°C. The mean specific heat of coke (with 10% ash) based upon the data of Terres and Schaller is given by Spiers (*Technical Data on Fuel*, 4th edition, 1935) as follows:

t°C.	Mean specific heat per °F. 21° to t°C. (B.Th.U. per lb.).	Heat capacity of 14.5 cwt. of coke (15—t°C.) (therms).
400	0.261	2.9
500	0.296	4.2
600	0.317	5.4
700	0.335	6.7
800	0.348	8.0
900	0.360	9.3
1000	0.369	10.6
1,100	0.377	12.6

The quantity of heat absorbed per 12 lb. of carbon gasified—*viz.*, 50,700 B.Th.U.—refers to steam at 100°C., carbon at 15°C., and products at 15°C. The following conditions may be assumed to relate to continuous vertical retorts, steam at 850°C., coke at 1,000°C., and exit gases at 300°C., in which case the reaction may be expressed:

$$\underset{12\text{ lb. at }1{,}000^\circ\text{C.}}{C} + \underset{18\text{ lb. at }850^\circ\text{C.}}{H_2O} = \underset{\text{at }300^\circ\text{C.}}{CO + H_2} - 40{,}000\text{ B.Th.U.}$$

If the gases leave the retort at 600°C. as with intermittent practice, the endothermicity is increased to 48,000 B.Th.U. per 12 lb. of carbon.

From the previous section it was deduced that in continuous retorts, the sensible heat in the coke between 1,000° and 850°C. amounts to 2 therms per ton of coal. It would appear, therefore, that this quantity of heat is capable of gasifying up to 60 lb. of carbon and so producing 3,860 cu.ft. or 12 therms of water gas without incurring extra fuel consumption. This agrees with the generally accepted view based upon the work of the Fuel Research Board and the Gas Investigation Committee—*viz.*, *that the first 5% steaming is very profitable, but that at higher degrees of steaming the water gas produced incurs at least as great a fuel expenditure per therm as does coal gas production.*

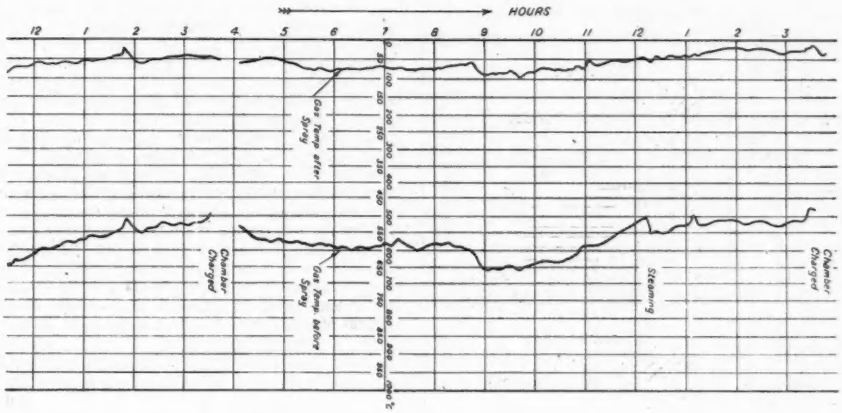

FIG. 8.

The temperature of the coke leaving a continuous vertical retort—*i.e.*, just above the extractor—depends upon whether cooling of the lower part of the retort with secondary air is practised and also upon the degree to which steaming is employed.

Ordinarily the reaction between steam and coke is so slow below 850°C. that this can be considered the lower limit to which the water gas reaction can be employed for coke cooling.

Even if the steam is pre-heated to 850°C. entirely by heat transfer from the hot coke, the coke cannot be cooled below 785°C. with 5% steaming and 725°C. with 10% steaming. The desirability of using secondary air for cooling the bottom of the retort and the adjoining ironwork is therefore apparent. In addition to the appreciable saving of fuel so effected the bottom steelwork is preserved and cooler working conditions are secured.

Experience shows that the secondary air can be pre-heated to about 450°C. by coke cooling, thus absorbing 3 therms per 14.5 cwt. of coke or per ton of coal.

The limiting degrees of coke cooling from 1,000°C. by the different agencies may be summarized as follows:

Temperature of coke, °C.	Cooling agency.	Heat recovered per 14.5 cwt. of coke (therms).
1000 to 850	Water gas reaction	2.0
850 to 785	Superheating 112 lb. of steam to 850°C.	0.75
785 to ?	Pre-heating secondary air to 450°C.	3.0
	Total recovered	5.75

Calculated heat left in coke = 10.6 — 5.75 = 4.8 therms.
Calculated temperature of coke leaving retort = 550°C.

In practice, when carbonizing Durham coal with about 5% steaming the temperature of the centre of the coke charge leaving the retort itself is about 650°C., and the heat carried by 14.5 cwt. of coke or per ton of coal is about 6 therms instead of about 4.8 therms calculated in the foregoing calculation.

IV. *The Heat Absorbed by the Steaming of Retorts.*

When steam reacts with carbon at a high temperature the principal reaction is—

$$\underset{12\text{ lb.}}{C} + \underset{18\text{ lb.}}{H_2O} = \underset{2\frac{1}{2}\text{ therms}}{CO + H_2} - 50{,}700\text{ B.Th.U.}$$

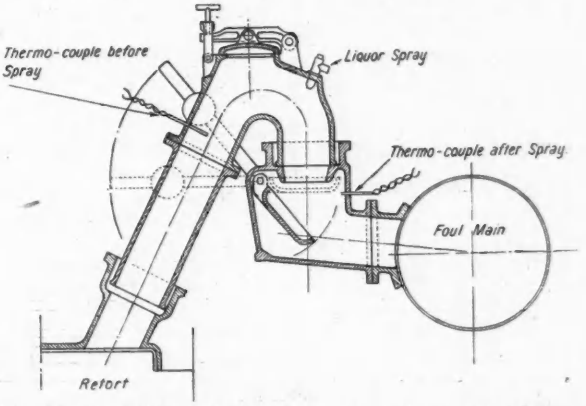

FIG. 9.—*Top Offtake and Liquor Spray. Intermittent Vertical Retorts.*

V. *The Thermal Reactions in the Carbonization of Coal.*

H. Hollings and J. W. Cobb (*Trans. I.G.E.* (1914), 225–253) studied qualitatively the thermal reactions involved in the carbonization of a Yorkshire coal, and concluded that the net quantity of heat evolved in heating coal up to 1,100°C. is probably very small, the predominantly exothermic changes between 600° and 750°C. being counter-balanced by the endothermic changes at lower temperatures.

More recently E. Terres (*Proc. 2nd Int. Conf. Bit. Coal* (1928 **2**, 657–684) has made calorimetric measurements of the thermal reactions involved in carbonizing a large number of Continental coals and also three Durham coals at various temperatures up to 1,100°C. The

* Paper to the London and Southern District Junior Gas Association.

results for the three Durham coals at 1,000°C. were 0 ± 50 B.Th.U. per lb. as shown below:

Ravensworth Pelaw	0 + 50	B.Th.U.	per	lb. (exothermic).
Boldon	0 + 35	,,	,,	(,,).
Easington	0 − 50	,,	,,	(endothermic).

For the purpose of this Paper it is proposed to assume that the carbonization of mixed Durham coal is thermally neutral.

VI. *Radiation and Convection Losses from the Carbonizing Unit.*

Surveys of the surface temperatures of coke oven batteries have been made by K. Baum (*Fuel in Science and Practice* (1930), **9**, 312–337) and by the American Gas Association Carbonization Committee (1926). Their calculations of the heat lost by radiation plus convection are in good agreement with an average result of 400 B.Th.U. per sq. ft. per hr.

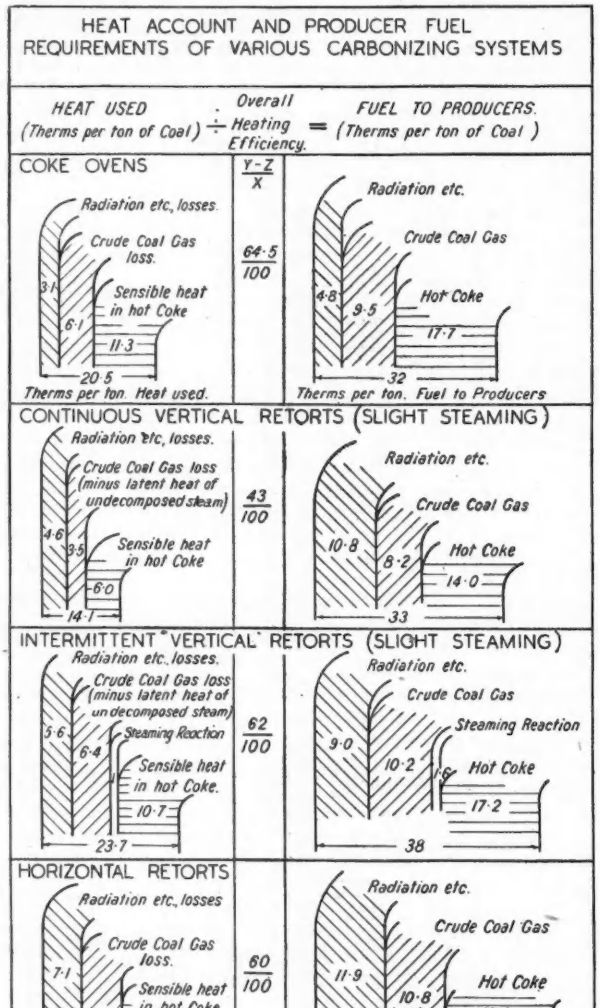

FIG. 10.

One of our installations of intermittent vertical retorts, with a normal cabonizing capacity of 150 tons of Durham coal per day, is frequently maintained hot in readiness for carbonization. The fuel consumed per day is 3.9 tons, which corresponds to a heat input to the combustion chambers of 41 therms per hour, of which 15 therms are carried away by the waste gases. The surface area of the installation (excluding the producer block below the level of the bottom of the retorts) is 6,950 sq. ft. The average heat loss per sq. ft. of surface is thus 370 B.Th.U. per hour. The flue temperatures and surface temperatures are somewhat lower than normally, but calculations show that the average heat loss per sq. ft. of surface in average practice is not greater than 500 B.Th.U. per sq. ft. per hour.

The surface areas of typical installations of carbonizing plants with their full load carbonizing capacities in terms of Durham coal are given in Table VI.

TABLE VI.

Type of plant.	Surface area (sq.ft.).	Durham coal per day (tons) (full load capacity).	Surface area per ton of coal per hr. (sq.ft.).	Heat lost* by convection plus radiation per ton of Durham coal (therms).
Coke ovens (excluding producers)	16,100	630	610	3.1
Continuous vertical retorts (excluding producers)	13,300	350	910	4.6
Intermittent vertical retorts (excluding producers below retorts) ...	7,000	150	1,120	5.6
Horizontal retorts (excluding producers below main flue)	9,100	155	1,410	7.1

* At a rate of 500 B.Th.U. per sq.ft. per hour.

Fuel Account for Various Carbonizing Systems.

In the light of the foregoing discussion let us try to account for the fuel consumption of various carbonizing plants and, compare the results so predicted with those obtained in actual practice.

The data are set out in Tables VII and VIII and illustrated in fig. 10. *The most striking feature is the smaller amount of heat carried away by the crude coal gas and the coke leaving a continuous vertical retort compared with static carbonization. This is due to recovery of heat from the outgoing coal gas by incoming coal and to the absorption of heat from the coke by steaming and by pre-heating the secondary air. This enables the continuous vertical retort to achieve almost as low a fuel consumption as the coke oven without any heat recuperation or regeneration from the waste gases. Since the waste gases from a continuous vertical retort setting can then be readily applied to steam raising, the performance of the continuous vertical retort is remarkably good. A comparable position can be attained by the coke oven with the adoption of dry cooling of the coke and recovery of the sensible heat in the form of high pressure steam.*

The higher fuel consumption of the intermittent vertical retort compared with the coke oven is due to the slightly greater heat loss from the setting and the absorption of heat by steaming reactions.

For the horizontal retorts, for which less complete data exist, it has been assumed that even though the producers are fed with hot coke, the efficiency of producers plus recuperators is rather lower than for the intermittent vertical retorts. The heat loss from horizontal retort settings is considerably greater per ton of coal than from other types of carbonizing plants.

TABLE VII—CARBONIZATION OF DURHAM COAL (8% ASH PLUS MOISTURE).

	Coke ovens.	Continuous vertical retorts (slight steaming).	Intermittent vertical retorts (slight steaming).	Horizontal retorts.
Gas yield including constituents* removed in purification (cu.ft. per ton)	12,650	14,250	14,900	13,400
Tar yield (galls., dry, per ton) ...	9	11	13	10
Calorific value of purified gas (B.Th.U. per cu.ft.)	600	535	550	560
Temperature of saturated gas leaving bench (°F.)	175	158	173	—
Dry coke and breeze yield (cwt. per ton)	14.8	14.6	13.9 (1.0 pad)	14.6
Temperature of coke leaving retorts (°C.)	1,025	650	980	1,000
Sensible heat in coke leaving retorts (therms per ton)	11.3	6.0	10.7	10.9
Endothermicity of water gas reaction (therms per ton)	*Nil*	Small	1.0	*Nil*
Sensible and latent heat in crude gas leaving retorts† (therms per ton)	6.1	4.0-0.5†	6.7-0.3†	6.4
Radiation and convection (therms per ton)	3.1	4.6	5.6	7.1
Heat required (therms per ton), total	20.5	14.1	23.7	24.4

* Including 400 cu.ft. of CO_2, H_2S, and NH_3 removed in purification.
† Less latent heat of undecomposed part of steam added to retorts.

TABLE VIII.—CARBONIZATION OF DURHAM COAL (8% ASH PLUS MOISTURE).

	Coke ovens.	Continuous vertical retorts (slight steaming).	Intermittent vertical retorts (slight steaming).	Horizontal retorts.
Temp. of waste gases leaving setting (°C.) (basis 19.4% CO_2) ...	300	1,000	600	—
Therms per 12 lb. of carbon gasified:				
Heat in coke to producers (X) ...	1.832	1.861	1.861	—
Heat in producer gas (Y) ...	1.402	1.627	1.627	—
Heat in waste gas (Z)	0.22	0.83	0.47	—
Heat utilized (Y-Z)	1.182	0.797	1.157	—
Overall efficiency 100 $\frac{(Y-Z)}{X}$ ...	64.5%	43%	62%	Assumed 60% of calorific value of coke
Heat required from Table VII (therms per ton of coal) ...	20.5	14.1	23.7	24.4
Fuel consumption (therms per ton of coal)	32	33	38	41
Fuel consumption tons dry coke (10% ash) per 100 tons of coal ...	10.9	11.3	13.0	14
Fuel consumption obtained in practice tons dry coke (10% ash) per 100 tons of coal	10.8	11.1	13.3	14 to 15

It will have been noted that in Tables VII and VIII the heat of decomposition of coal has been neglected. In view of the almost exact agreement between the calculated and observed fuel consumptions it would seem, at any rate for Durham coal, that the carbonization is substantially thermally neutral.

Directions in which Further Improvements might be Obtained.

(1) *Coke Ovens.*—Pre-heating the primary air to the producers by heat exchange with the hot gas leaving the producers. This system was used in central Mond producer gas plants and accounted for about 5% fuel saving (H. A. Humphrey, *Proc. Inst. Civ. Eng.* (1896–97, Part III), **129**, 190–246.

(2) *Continuous Vertical Retorts.*—Although the overall fuel economy is so favourable this system probably offers the greatest scope for further improvement. It would appear from fig. 10 and Table VIII that some 30% of the fuel burnt is associated with the radiation and convection loss from the setting. This is not because of the greater intrinsic heat loss per unit of surface compared with other carbonizing plants, but because of the high proportion of heat carried by the waste gases which is only permissible on account of the small net heat requirement with this system of retorts. More heat insulation would be particularly profitable. Consideration has been given to heat insulation of settings by A. J. Dale and A. T. Green (*Trans. I.G.E.* (1927–28), 5889, 626).

In addition, more cooling medium is required for further absorption of heat from the coke in the upper part of the extractor casing and the lower part of the retorts. Although the transfer of heat from a solid mass of coke through a partition wall is not easy, it is well worth exploring because the cooling of the coke by a further 200°C.—*i.e.*, from 650°C. to 450°C.—would probably reduce the fuel consumption by 15% of the figure shown in Table VIII. The only additional cooling medium available is the primary air to the producers. The adoption of pre-heating the primary air would mean abandoning the use of water on the producer bars and the substitution of extra steam additions to the primary air, otherwise the pre-heat of the primary air would merely evaporate water. The simplest arrangement of applying primary air to the cooling of the bottom of the retorts might be to reserve the producer side retorts for this purpose and to apply secondary air cooling to the non-producer side retorts. All retort castings, &c., would then receive double the cooling medium compared with the present practice of using secondary air only.

(3) *Intermittent Vertical Retorts.*—In this instance considerable alterations in design would be required to effect substantial economy of fuel. The only method available would seem to be an extension of the recuperator with the use of both primary and secondary air for cooling the waste gases. In this way the waste gases might be cooled to 400°C. and about 14% of the fuel saved, thus reducing the fuel requirements from 13.3 to 11.5 tons per 100 tons of coal. The waste heat boilers would in consequence be dispensed with and logically dry cooling of the coke should be applied.

(4) *Horizontal Retorts.*—The problem here is difficult and can only follow the same lines as for intermittent vertical retorts, with the addition that greater insulation of the settings is worthy of consideration.

Acknowledgments

I should like to thank the Directors of The Gas Light and Coke Company for the unique facilities provided for these investigations and for permission to publish the Paper, and the Company's Engineers, Chemists, and Draughtsmen for their co-operation, especially Dr. A. E. Haffner and Dr. F. R. Weston.

APPENDIX 1.

Pound Molecule.

Gases are generally measured by volume, while gas analyses are given in per cent. by volume. Solids, on the other hand, are mostly measured by weight. Since in the Gas Industry we are concerned with the conversion of solids into gas it would be helpful to have a simple basis of correlating units of weight and volume.

This system conveniently exists in the term gramme-molecule as expressed below. According to Avogadro's hypothesis (1810), "Equal volumes of all gases at the same temperature and pressure contain the same number of molecules." Therefore, the weights of equal volumes of various gases at a standard temperature and pressure—*e.g.*, 0°C. and 760 mm. pressure—are proportional to their molecular weights. Thus, since—

2 grammes of hydrogen occupy 22.42 litres dry at 0°C. and 760°C. mm.

it follows that—

32 grammes of oxygen,
or 28 ,, of nitrogen,
or 44 ,, of carbon dioxide also occupy 22.42 litres dry at 0°C. and 760°C. mm.

This very useful concept was translated into English units by J. W. Richards—*Metallurgical Calculations*, McGraw Hill, 1st edn.. 1906—who pointed out that "by a strange coincidence* the same factor can be used for English units as in the metric system." In other words—

2 ounces of hydrogen = 22.42 cu.ft. dry at 0°C. and 760 mm.,
and 32 ounces of oxygen,
or 28 ounces of nitrogen,
or 44 ounces of carbon dioxide, &c., also occupy 22.42 cu.ft. dry at 0°C. and 760 mm.

It is unfortunate that the ounce-molecule was not popularized and that the pound-molecule came to be commonly used.

On a pound-molecular basis:

2 lb. of hydrogen,
or 32 lb. of oxygen,
or 28 lb. of nitrogen,
or 44 lb. of carbon dioxide occupy 359 cu.ft. dry at 0°C. and 760 mm. pressure or 386 cu.ft. satd. at 60°F. and 30 in. pressure (barometer as read at room temperature).

* This coincidence is due to the fact that water has a density of approximately 1,000 grammes per litre or 1,000 ozs. per cu. ft.; thus grammes per litre = ounces (av.) per cu. ft.

SENSIBLE HEAT OF GASES

(at atmospheric pressure) between 0° and t°C. (B.Th.U. per lb. molecule of gas.).

t°C.	O_2.	N_2.	Air.	CO.	H_2.	CO_2.	Water vapour.	CH_4
15.5	195	194	194	194	191	240	223	222
100	1,271	1,255	1,255	1,255	1,247	1,650	1,444	1,573
200	2,574	2,521	2,525	2,521	2,501	3,473	2,925	3,405
300	3,921	3,800	3,812	3,812	3,764	5,434	4,438	5,495
400	5,313	5,103	5,135	5,127	5,027	7,487	6,003	7,810
500	6,741	6,434	6,479	6,471	6,289	9,674	7,625	10,368
600	8,197	7,786	7,850	7,850	7,572	11,913	9,287	13,119
700	9,678	9,162	9,246	9,246	8,859	14,212	11,013	16,040
800	11,191	10,586	10,686	10,699	10,166	16,560	12,800	19,170
900	12,716	12,022	12,135	12,151	11,485	18,952	14,644	22,438
1000	14,257	13,482	13,607	13,627	12,817	21,385	16,524	25,859
1100	15,802	14,971	15,088	15,128	14,156	23,858	18,452	
1200	17,367	16,459	16,588	16,633	15,552	26,331	20,413	

Data mainly by Justi and Lüder from H. M. Spiers, *Technical Data on Fuel*, 4th edn. (1935).

Data per pound molecule of each gas.

	Weight (lb.).	Gross calorific value (therms).
Oxygen...	32	—
Nitrogen	28	—
"Air"	28.97	—
Carbon monoxide ...	28	1.217
Hydrogen	2	1.230
Carbon dioxide ...	44	—
Water vapour ...	18	—
Methane	16	3.830

Each pound molecule occupies a volume of 359 cu.ft. dry at O°C. and 760 mm. or 386 cu.ft. saturated at 60°F. and 30 in. pressure.*

* Barometer at room temperature.

APPENDIX 2.

(*a*) BRICK-BUILT STEP-GRATE PRODUCERS ATTACHED TO AN INSTALLATION OF CONTINUOUS VERTICAL RETORTS.

Duration of test (hours)			210
Type of fuel—Run of retort coke 2.7% moisture, 12% size 0 in. to ⅝ in.			
Dry weight of coke charged (tons)			277
Ultimate analysis of coke (dry) (%):			
Carbon	88.0		
Hydrogen ...	0.5		
Ash	9.7		
Nitrogen, &c. ...	1.8		
	100.0		
Calorific value (B.Th.U. per lb.)			13,100
Dry ashes withdrawn (tons)			35
Clinker	15 tons		
Fine Ash ...	14 ,,		
Coke (12% Ash)	6 ,,		
Ultimate analysis of dry ashes (%):			
Carbon	28		
Ash	70		
Calorific value (B.Th.U. per lb.)			4,000
Number of producers			7
Grate area per producer (sq.ft.)			34
Depth of fuel bed, grate to curtain arch (ft.)			6
Carbon gasified per sq.ft. of grate area (lb./hr.)			10.5
Steam added to primary air (lb. per lb. of dry coke):			
(*a*) As steam			*Nil*
(*b*) As water evaporated from grate			0.38
Analysis of producer gas (%):			
CO_2	5.6		
CO	26.6		
H_2	7.8		
CH_4	0.1		
N_2	59.9		
	100.0		
H_2O	4.2 vols. per 100 vols. dry gas.		
Temperature of producer gas entering retort setting (°C.)			830

Thermal account (per 100 lb. dry coke fed to producers).
100 lb. of coke (dry) to producers contain 88 lb. carbon.
12.6 lb. of ashes (dry) from producers contain 3.5 lb. carbon.
Carbon gasified 84.5 lb.

84.5 lb. of carbon = $\frac{84.5}{12}$ = 7.04 lb. molecules.

Carbon content of producer gas = (5.6 + 26.6 + 0.1) = 32.3% by volume.
Producer gas yield (per 100 lb. of dry coke to producers)

$$= \frac{100}{32.3} \times 7.04 = 21.8 \text{ lb. molecules.}$$

= 21.8 × 386 = 8,420 cu.ft. (moist at 60° F. and 30 in. pressure).

Calorific value of producer gas (B.Th.U. per cu.ft.):

(*a*) Gross:

CO	... ...	26.6% × 315 = 83.8
H_2	... ...	7.8% × 318 = 24.8
CH_4	... ...	0.1% × 993 = 1.0
		109.6

(*b*) Net (gross C.V. minus % total hydrogen × 0.50) 105.6

Heating value of producer gas (from 100 lb. of dry coke to producers):
8,420 × 109.6 B.Th.U. = 9.23 therms (gross)
8,420 × 105.6 B.Th.U. = 8.89 therms (net).

Sensible heat of hot producer gas at 830°C. (above 15°C.).

	%	lb. molecule.	Sensible heat (830—15°C.) B.Th.U. per lb. molecule.	Therms.
CO_2	5.6	1.22	17,270 — 235 = 17,035	0.208
CO	26.6	5.80	11,145 — 188 = 10,957	0.637
H_2	7.8	1.70	10,560 — 186 = 10,374	0.176
CH_4	0.1	0.02	20,150 — 218 = 19,932	0.004
N_2	59.9	13.06	11,010 — 188 = 10,822	1.410
Total	100.0	21.8		
H_2O	4.2	0.92	13,360 — 216 = 13,144	0.120
			Total ...	2.555

Latent heat of undecomposed steam in producer gas
0.92 × 18 × 1055 B.Th.U. 0.175
Latent heat of water of combustion of producer gas
(9.23 — 8.89)therms 0.34
Heat of combustion of ashes 12.6 × 4,000 B.Th.U. 0.504

Heat balance (above 15°)	Therms per 100 lb. dry coke to producers.	Therms per 12 lb. of carbon gasified.	%
Input.			
Heat of combustion of coke (gross) (sensible heat of coke and total heat of air negligible)	13.10	1.861	100
Output.			
Heat of combustion of producer gas (net)	8.89	1.263	67.9
Latent heat of water of combustion ...	0.34	0.048	2.6
Sensible heat of hot producer gas ...	2.56	0.364	19.5
Latent heat of undecomposed steam ...	0.18	0.026	1.4
Heat of combustion of ashes	0.50	0.071	3.8
Losses (by difference)	0.63	0.089	4.8
	13.10	1.861	100.0

Hot gas efficiency (67.9 + 2.6 + 19.5) = 90.0% (gross).
Hot gas efficiency (67.9 + 19.5) = 87.4% (net).

(*b*) Rotary Grate Producers (Coke Oven Plant).

Duration of test (hours) 192

Type of fuel (1 part breeze, o—¼ in.)
(2 parts small coke)

Grading test of dry fuel (%).

Above 1¼ in.	13.8
1¼ in. to ½ in.	38.2
½ in. to ⅛ in.	25.4
⅛ in. to ¼ in.	12.8
Below ¼ in.	9.8
Total	100.0

Moisture content of wet fuel (%) 16.7
Fuel (dry) charged to each of 8 producers per day (tons) ... 16.46

Ultimate analysis of dry fuel (%):

Carbon	86.6
Hydrogen	0.6
Ash	10.2
Nitrogen, &c.	2.6
	100.0

Calorific value (B.Th.U. per lb.) 12,960
Ashes (dry) withdrawn (tons per 100 tons of dry fuel) ... 11.5

Analysis of ashes (dry) (%):

Carbon	10.5
Ash	88.4

Calorific value (B.Th.U. per lb.) 1,500
Dust recovered from scrubbers (tons (dry) per 100 tons of dry fuel) 0.6

Analysis of dust (dry) (%):

Carbon	79.3

Calorific value (B.Th.U. per lb.) 11,500
Number of producers at work 8
Cross sectional area of each producer (sq.ft.) 56.5
Carbon gasified per sq.ft. of cross section (lb./hr.) 23.1
Saturation temperature of primary air (°C.) 57.5
Steam in primary air (lb. per lb. dry fuel) 0.56

Analysis of producer gas (%).

CO_2	5.4
CO	27.5
H_2	11.7
CH_4	0.2
N_2	55.2
	100.0
H_2O	8.9 vols. per 100 vols. dry gas

Temperature of producer gas leaving producers (°C.) ... 405
Steam raised in annular boilers at 4 lb. per sq.in. gauge pressure (lb. per lb. dry fuel) 0.9
Steam consumption of turbine driving blower and exhauster (at 97 lb. per sq.in. and 335°F.) = 5,500 lb. per hr. for 8 producers.

Thermal account (per 100 lb. of dry fuel to producers).
100 lb. of fuel (dry) to producers contain 86.6 lb. of carbon.
11.5 lb. of ashes (dry) from producers contain 1.2 lb. of carbon.
0.6 lb. of dust (dry) from scrubbers contain 0.5 lb. of carbon.
Carbon gasified ... 84.9 lb.

84.9 lb. of carbon = $\frac{84.9}{12}$ = 7.075 lb. molecules.

Carbon content of producer gas = (5.4 + 27.5 + 0.2) = 33.1% by volume.
Producer gas yield per 100 lb. of dry fuel to producers

$$= \frac{100}{33.1} \times 7.075 = 21.4 \text{ lb. molecules.}$$

= 21.4 × 386 = 8,270 cu.ft. (moist at 60°F. and 30 in. pressure).

Calorific value of producer gas (B.Th.U. per cu.ft.):

(*a*) Gross:

CO	27.6%	× 315 = 86.9
H_2	11.7%	× 318 = 37.2
CH_4	0.2%	× 995 = 2.0
		126.1

(*b*) Net:
(Gross C.V. — % total hydrogen × 0.50) = 120.0

Heating value of producer gas (from 100 lb. dry fuel):
8,270 × 126 B.Th.U. = 10.42 therms (gross)
8,270 × 120 B.Th.U. = 9.92 therms (net).

Sensible heat of hot producer gas at 405°C. (above 15°C.).

	%.	lb. molecule.	Sensible heat (405°—15°C.) B.Th.U. per lb. molecule.	Therms.
CO_2	5.4	1.15	7,598 — 235 = 7,363	0.0847
CO	27.5	5.90	5,195 — 188 = 5,007	0.2950
H_2	11.7	2.50	5,080 — 186 = 4,894	0.1225
CH_4	0.2	0.04	7,936 — 218 = 7,718	0.0031
N_2	55.2	11.81	5,167 — 188 = 4,979	0.5880
Total	100.0	21.4		
H_2O	9.0	1.92	6,085 — 216 = 5,869	0.1127
			Total ...	1.2060

Latent heat of undecomposed steam in producer gas
1.9 × 18 × 1,055 B.Th.U. 0.362
Latent heat of water of combustion of producer gas
(10.42—9.92) therms 0.50
Heat of combustion of ashes 11.5 × 1,500 B.Th.U. 0.173
Heat of combustion of dust 0.6 × 11,500 B.Th.U. 0.069
Heat in steam from annular boiler surplus to providing for saturating primary air (90—56) × 1,132 B.Th.U. ... 0.385

Heat Balance (above 15°C.)	Therms per 100 lb. of dry fuel to producers.	Therms per 12 lb. of carbon gasified.	%
Input.			
Heat of combustion of fuel (gross) ... (Sensible heat of coke and total heat of air negligible. Steam for primary air provided from annular boiler.)	12.96	1.832	100
Output.			
Heat of combustion of producer gas (net)	9.92	1.402	76.6
Latent heat of water of combustion of producer gas	0.50	0.071	3.9
Sensible heat of hot producer gas ...	1.21	0.171	9.3
Latent heat of undecomposed steam in producer gas	0.36	0.051	2.8
Heat of combustion of ashes	0.17	0.024	1.3
dust	0.07	0.010	0.5
Heat in surplus steam from annular boiler	0.39	0.055	3.0
Losses (by difference)	0.34	0.048	2.6
	12.96	1.832	100.0

Hot gas efficiency (76.6 + 3.9 + 9.3) = 89.8% (gross)
Hot gas efficiency (76.6 + 9.3) = 85.9% (net).
Cold gas efficiency = 76.6% (net).

APPENDIX 3.

Total Heat in Coal Gas Saturated with Water Vapour.

Units—Heat calculated from 32°F. B.Th.U.
Unit volume of gas 100 cu.ft. measured saturated at 60°F. and 30 in.
Sensible heat of unit volume of gas taken as 2.03 B.Th.U. per °F.

Temperature °F.	Total pressure (in. mercury). 29.0	29.5	30.0	30.5	31.0
	Total heat (B.Th.U.).				
180	6,340	6,130	5,930	5,740	5,570
175	5,090	4,930	4,800	4,660	4,540
170	4,170	4,050	3,950	3,850	3,760
160	2,920	2,860	2,790	2,730	2,680
150	2,120	2,070	2,030	1,990	1,950
140	1,560	1,540	1,510	1,490	1,460
130	1,170	1,150	1,130	1,110	1,090
120	880	865	855	845	835
110	670	660	650	640	630
100	500	495	490	485	480
90	384	379	375	370	366
80	287	283	280	277	273
70	211	208	206	204	202
60	150	149	147	146	143
50	100	99	98	97	96

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ISSUED BY THE NATIONAL SAVINGS COMMITTEE

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INSTITUTION OF GAS ENGINEERS

THIRD REPORT OF THE CHAIRMEN'S TECHNICAL COMMITTEE, 1941-42

THE membership of the Chairmen's Technical Committee is: Sir Frederick J. West, C.B.E., J.P., M.Inst.C.E., M.I.Mech.E. (*Chairman*); E. V. Evans, O.B.E., F.I.C. (*Vice-Chairman*); F. M. Birks, O.B.E., M.I.Mech.E.; Charles F. Botley, M.Inst.C.E.; George Dixon, B.Eng., M.Inst.C.E.; H. J. Escreet, B.Sc.(Eng.); Stephen Lacey, B.Sc., M.Inst.C.E.; T. F. E. Rhead, M.Sc., F.I.C.; R. J. Rogers; John Terrace, M.Inst.C.E.; the President, the two Vice-Presidents, and the Honorary Secretary of the Institution (*ex officio*).

In view of the many urgent calls upon the members of the Technical Committees in connexion with the work of their undertakings in furthering the national effort, the number of meetings of these Committees has been largely reduced during the past year. The work of the Chairmen's Technical Committee has been correspondingly restricted.

Collaboration with Government Departments has continued and the Technical Committees have been called into consultation on many matters. This work has found expression mainly in the form of confidential Memoranda which have been circulated to gas undertakings. Accordingly, and owing to the limitations imposed by the shortage of paper, separate reports of the work of the Technical Committees have not been published.

The Council, at the request of the Ministry of Works and Planning, has set up a new Committee—namely, the Gas Installations Committee—which has been asked to make recommendations through the Council to the Ministry concerning gas installations in post-war buildings. In view of the prospect of a great development of building after this war and of the recommendations in the Report of Lord Justice Scott's Committee on Land Utilization in Rural Areas, the work of the Gas Installations Committee is likely to be of great practical importance to the Gas Industry.

The Institution is also represented, by the Chairman of the Gas Installations Committee, on the newly-formed Standards Committee and Mechanical Installations Committee of the Ministry of Works and Planning. These Committees are all closely inter-related.

The Institution has continued to co-operate with the Parliamentary and Scientific Committee. This Committee has been particularly concerned with the proper employment of scientific personnel in furtherance of the war effort.

The Joint Committee on Materials and their Testing, of which the Institution is a founder member, remains in being, but its technical discussions have been suspended for the present.

The Institution of Gas Engineers continues, through the Gas Industry Committee, Technical Committees and otherwise, to co-operate with the British Standards Institution in the preparation of British Standard Specifications.

The Institution Gas Research Fellowship, awarded in 1941 to J. E. Garside, Ph.D., has been extended for a further year.

Domestic Heating Committee

The membership of the Domestic Heating Committee is: Stephen Lacey, B.Sc., M.Inst.C.E. (*Chairman*); J. E. Davis; Harold Hartley, D.Sc.; F. O. Hawes; C. A. Masterman, M.A., M.I.Mech.E., F.I.C.; the President, two Vice-Presidents, and the Honorary Secretary of the Institution (*ex officio*).

Society of British Gas Industries' Nominees: H. Angus, M.Sc., Ph.D.; T. F. C. Potterton.

The activities of the Committee have been restricted during the past year. The Committee, however, has had under review the thermal efficiency of various domestic heating appliances. It is impressed with the desirability of designing gas fires with a higher correction component, or otherwise of increasing the thermal efficiency of domestic gas appliances for use in post-war buildings. The Committee has also collected and considered the somewhat disjointed information that is available concerning ventilation and building construction, and has prepared a memorandum on this subject.

Gas Installations Committee

The membership of the Gas Installations Committee is: R. J. Rogers (*Chairman*); B. J. Bell; H. M. Browne; R. D. Keillor; Stephen Lacey, B.Sc., M.Inst.C.E.; R. N. Le Fevre, Assoc.M.I.Mech.E.; H. P. Lupton, B.Sc.; J. M. A. Mitchell; H. Singleton, M.I.Mech.E.; N. S. Smith. *Co-opted:* Francis Lorne, F.R.I.B.A.

The Council of the Institution, at the request of the Director General of Post-War Building of the Ministry of Works and Planning, set up in May, 1942, a Gas Installations Committee, with the above-mentioned membership. This Committee is one of a number of Study Committees of the Directorate of Post-War Building of the Ministry of Works and Planning. It has the advantage of including amongst its members Mr. Francis Lorne, F.R.I.B.A., who is both an Assistant Director of the Directorate of Post-War Building, and an expert on standardization.

The terms of reference of the Committee are "To review existing information and practice concerning gas installations in buildings, from the point of entry of the gas to the property boundary up to the point of its delivery to an appliance, and to make recommendations for practice in post-war buildings."

The Committee has drafted its recommendations in respect of the installation of gas service pipes, distributing pipes (carcass pipes), and meters, and is now similarly considering matters relating to the installation of appliances. It has prepared models and drawings to illustrate these recommendations.

Gas-Works Safety Rules Committee

The membership of the Gas Works Safety Rules Committee is: F. M. Birks, O.B.E., M.I.Mech.E. (*Chairman*); H. E. Bloor, B.Sc., B.Eng.; G. le B. Diamond, M.I.Mech.E.; Thomas Carmichael, J.P., M.Inst.C.E.; J. E. Davis; Thomas Hardie, M.Inst.C.E.; L. Hartley, M.I.Mech.E.; H. Hollings, D.Sc., F.I.C.; James Jamieson; G. C. Pearson, M.Inst.C.E.; T. F. E. Rhead, M.Sc.; C. S. Shapley, M.Inst.C.E.; Col. H. C. Smith, J.P., M.Inst.C.E.; E. G. Stewart; the President, the two Vice-Presidents, and the Honorary Secretary of the Institution (*ex officio*). *Co-opted:* L. F. Stemp, B.A., LL.B.

The Committee has to report with regret the death, on April 12, of Mr. J. M. Campbell, J.P. (Margate), who had been one of its members for many years.

The Committee records with regret the resignation of Mr. J. W. Napier, M.B.E. Mr. G. le B. Diamond has recently been appointed to serve on the Committee.

Several meetings of the Committee have been held during the past year.

The Committee has continued to co-operate with the appropriate Government Departments on Air Raid Precautions. A Sub-Committee has been set up to deal with matters specifically relating to Civil Defence. A confidential memorandum has been circulated to all gas undertakings, dealing with some useful experiences of undertakings in this connexion.

There followed a Memorandum on a Scheme of Precautions against Frost on a Gas-Works—see "JOURNAL," Dec. 16.

Seals on Purifier Boxes.—Information regarding materials for use for seals on purifier boxes may be obtained on application to the Secretary of the Institution.

Wind Forces on Spirally-Guided Gasholders.—An interim report from the National Physical Laboratory on the Wind Tunnel Experiments on Spirally-Guided Gasholders is now under consideration by the Committee.

Gasholder Record Sheets.—The demand continues for Gasholder Record Sheets for both low and high pressure gasholders.

Joint Lighting Committee

The membership of the Joint Lighting Committee is: *Institution Nominees:* George Dixon, B.Eng., M.Inst.C.E. (*Chairman*); A. Maurice Bell; W. J. A. Butterfield, M.A., F.I.C.; W. J. G. Davey, B.Sc.; J. E. Davis; E. V. Evans, O.B.E., F.I.C.; J. Weatherall Foreman; A. G. Higgins; A. L. Holton; James Jamieson; Stephen Lacey, B.Sc., M.Inst.C.E.; A. R. McGibbon; C. A. Masterman, M.A., M.I.Mech.E., F.I.C.; F. C. Smith; C. I. Winstone.

Society of British Gas Industries Nominees: W. R. Edgar; Col. C. J. Falk; F. J. Gould; C. H. A. Kempton; R. J. Rogers; H. R. Stevenson; Philip H. Sugg.

Affiliated District Gas Associations Nominees: James Dickson (North British); E. M. Edwards (Wales and Monmouthshire); E. Howard (Midland); H. W. Saville (Irish); H. Singleton, M.I.Mech.E. (Manchester); W. S. Stredwick (Southern); J. E. White (North of England); George Wright (Eastern Counties).

Ex officio: The President, two Vice-Presidents, and the Honorary Secretary of the Institution.

Following upon the implementation of the Fifth Report on Lighting in Factories by the issue of Statutory Rules and Orders, 1941, No. 94, there have been no further alterations in the standards of lighting for factories.

The Joint Lighting Committee has considered the future of gas lighting for various purposes.

At the request of the Post-War Planning Committee of the British Gas Federation, the Committee has undertaken to submit evidence on gas lighting (domestic, public, factory, &c.) to the Lighting Committee of the Ministry of Works and Planning.

The Committee continues to maintain contact with Government Departments concerned with lighting matters, with the National Illumination Committee of Great Britain, the Illuminating Engineering Society, and the Association of Public Lighting Engineers.

Liquor Effluents and Ammonia Committee

The membership of the Liquor Effluents and Ammonia Committee is: Charles F. Botley, M.Inst.C.E. (*Chairman*); T. Lewis Bailey, Ph.D., F.I.C.; H. T. Calvert, M.B.E., D.Sc., Ph.D., F.I.C.; Prof. J. W. Cobb, C.B.E., D.Sc.; W. A. Damon, B.Sc., F.I.C.; E. V. Evans, O.B.E., F.I.C.; H. Hollings, D.Sc., F.I.C.; P. N. Langford; P. G. G.

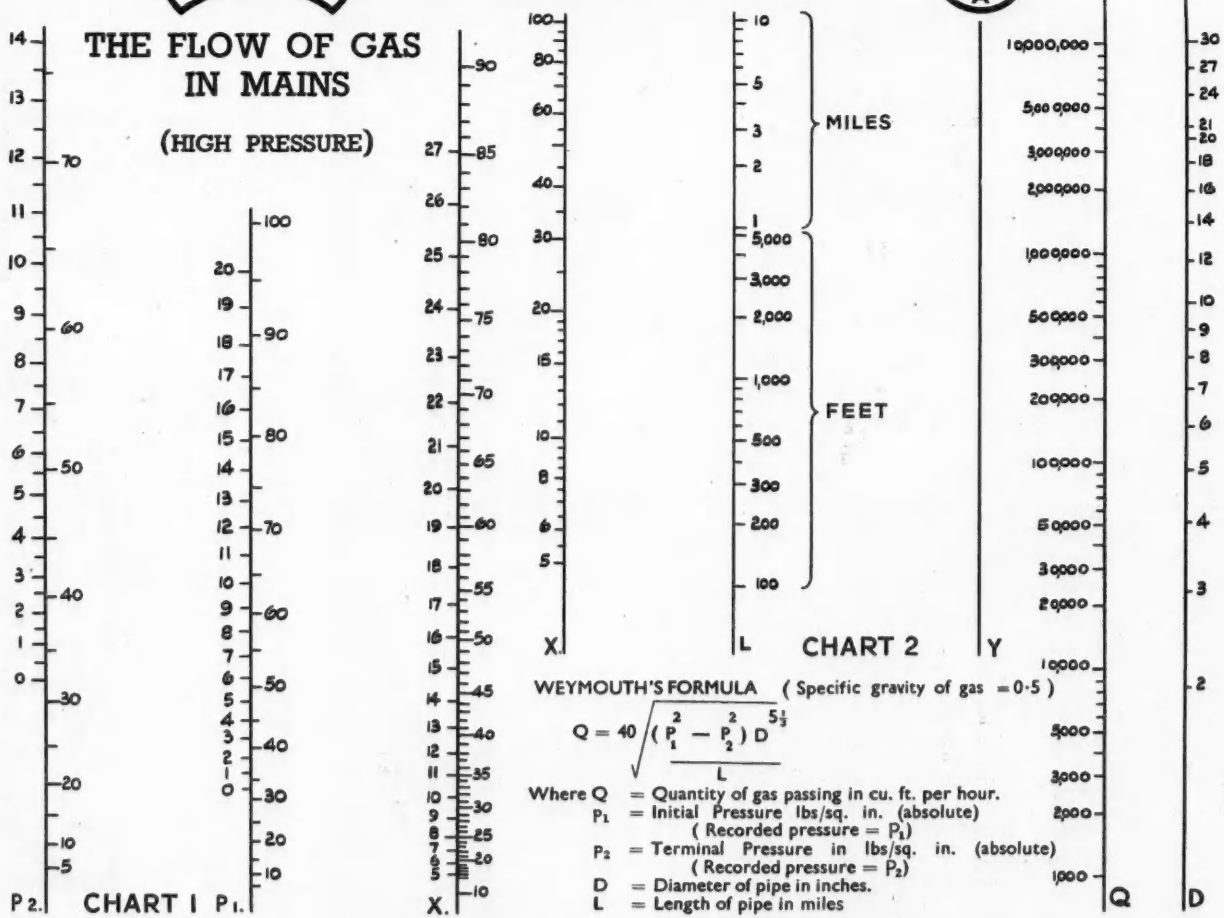
January USE OF NOMOGRAM The following example shows the No 4 NOMOGRAM PARKINSON

PARKINSON

NOMOGRAM No. 4A

THE FLOW OF GAS IN MAINS

(HIGH PRESSURE)



WEYMOUTH'S FORMULA (Specific gravity of gas = 0·5)

$$Q = 40\sqrt{\frac{(P_1^2 - P_2^2)\,D^{5\frac{1}{3}}}{L}}$$

Where Q = Quantity of gas passing in cu. ft. per hour.
P_1 = Initial Pressure lbs/sq. in. (absolute)
(Recorded pressure = P_1)
P_2 = Terminal Pressure in lbs/sq. in. (absolute)
(Recorded pressure = P_2)
D = Diameter of pipe in inches.
L = Length of pipe in miles

To determine quantity of gas draw straight lines from

(1) P_2	—P_1	—X	(Chart 1) to obtain	X
(2) X	—Y	—D	„ 2 „	Y
(3) L	—Y	—Q	„ 2 „	Q

To determine size of pipe draw straight lines from

(1) P_2	—P_1	—X	(Chart 1) to obtain	X
(2) L	—Y	—Q	„ 2 „	Y
(3) X	—D	—Y	„ 2 „	D

To find terminal pressure draw straight lines from

L	—Y	—Q	(Chart 2) to obtain	Y
D	—Y	—X	„ 2 „	X
X	—P_1	—P_2	„ 1 „	P_2

W.D.

This cancels and replaces Nomogram No. 4 published in "Gas Journal," December 23, 1942

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USE OF NOMOGRAM

The following example shows the method of using the Nomogram :—

Suppose the quantity of gas (Q) is required for a pipe 6 ins. in diameter (D) and 5280 feet (one mile) in length (L) when the initial and terminal pressures P_1 and P_2 are 50 lbs./sq. in. and 5 lbs./sq. in. respectively :—

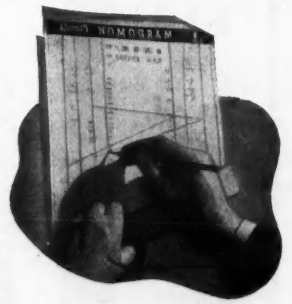
(1) (P_2 — P_1 — X Chart 1) Draw a straight line from 5 on scale P_2 through 50 on Scale P_1 to intersect Scale X at point 62.

(2) (X — Y — D Chart 2) Draw a straight line from point 62 on Scale X to 6 on Scale D intersecting Scale Y.

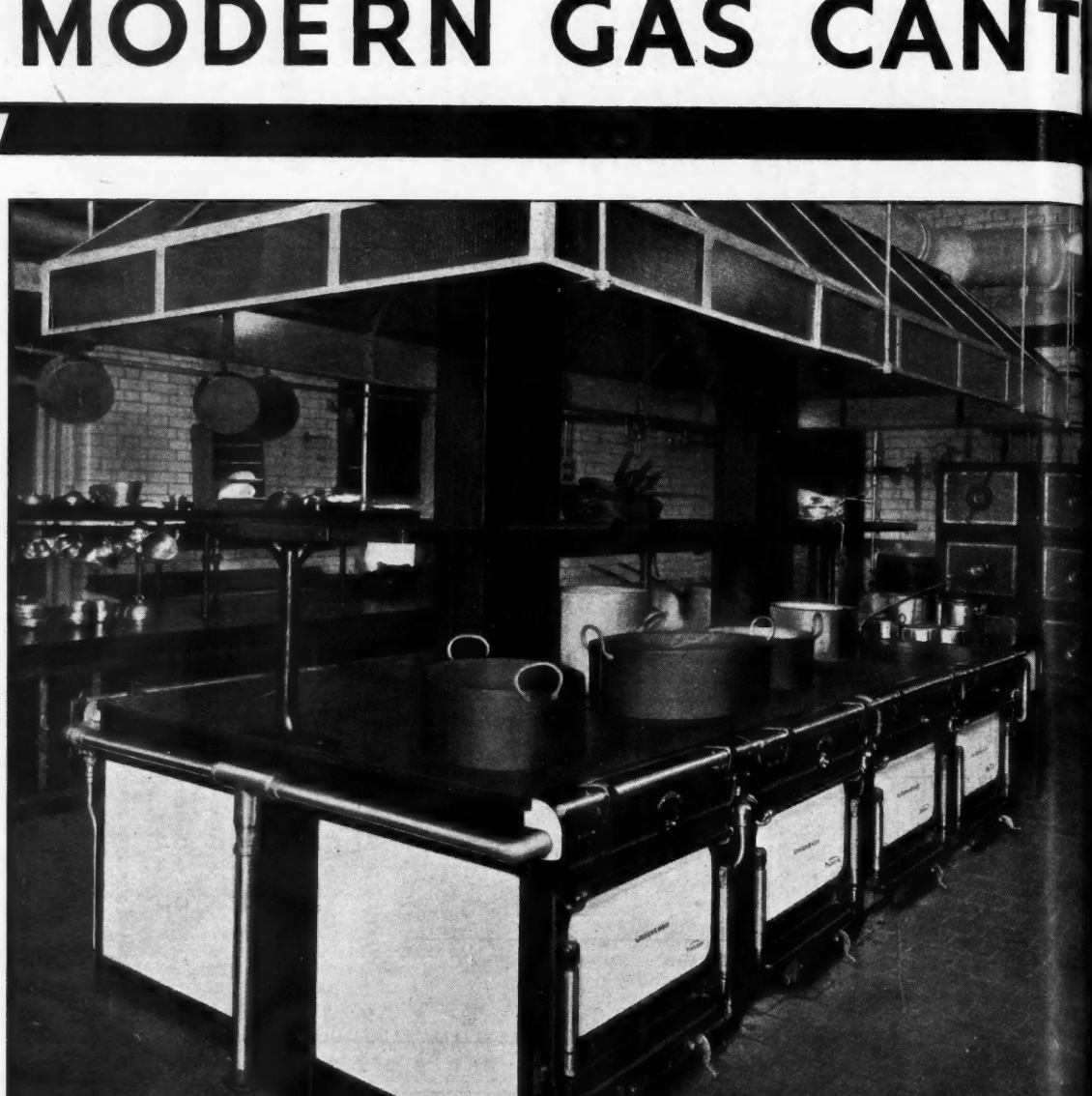
(3) (L — Y — Q Chart 2) Draw a straight line from 1 mile on Scale L through the point of intersection of Scale Y to intersect Scale Q at point just below 300,000.

Therefore the required gas rate is 300,000 cu. ft./hr. (by calculation 294,200 c. ft.).

NOTE.—Read values of P_2 P_1 and X on Chart 1, on the same sides of their respective scales.



MODERN GAS CANT



At an important Railway Centre. In addition to the 8-oven central Grosvenor Range here shown, this installation of Radiation large-scale cooking equipment also includes a Holborn Bain Marie, a Whitemount Pastry Oven and a Savoy Griller.

Radiation Ltd.

Moon, M.Inst.C.E.; A. Parker, D.Sc., F.I.C.; P. Parrish, F.I.C.; the President, the two Vice-Presidents, and the Honorary Secretary of the Institution (*ex officio*). *Co-opted:* L. F. Stemp, B.A., LL.B.

The Committee has received with regret the resignation of Prof. J. W. Cobb, C.B.E., D.Sc.(Leeds), as Honorary Secretary of the Committee.

The Committee has continued to meet regularly during the past year. Dr. A. Key, who was formerly engaged entirely on research work for the Committee, is now engaged on other investigations for the Gas Research Board, but his services are available to the Committee when required.

The Committee continues to be consulted and to give advice on the discharge of effluent from Gas Works, with particular reference to the Public Health (Drainage of Trade Premises) Act, 1937.

In order to assist in securing maximum recovery of ammonia, the Committee, at the request of the Ministry of Supply, arranged for the preparation by Dr. Key of a memorandum on "The Operation of Gas-Works Plant to Secure the Maximum Recovery of Ammonia and the Production of a Strong Ammoniacal Liquor," which was circulated to all gas undertakings on March 9.

Meters Committee

The membership of the Meters Committee is: John Terrace, M.Inst.C.E. (*Chairman*); H. E. Bennett, M.C.; R. J. H. Clark; C. M. Croft, D.L., J.P., M.Inst.C.E., M.I.Mech.E.; H. W. Hodgson; Stephen Lacey, B.Sc., M.Inst.C.E.; L. F. McLeod, O.B.E.; J. W. McLusky; R. G. Marsh, C. A. Masterman, M.A., M.I.Mech.E., F.I.C.; C. S. Shapley, M.I.Mech.E.; the President, the two Vice-Presidents, and the Honorary Secretary of the Institution (*ex officio*).

Pipes Committee

The membership of the Pipes Committee is: H. J. Escreet, B.Sc. (Eng.) (*Chairman*); F. Boardman, M.I.Mech.E.; L. F. McLeod, O.B.E.; R. G. Marsh; S. T. S. Musgrove; the President, the two Vice-Presidents, and the Honorary Secretary of the Institution (*ex officio*).

The Pipes Committee has not met this year, but confidential matters relating to Air Raid Precautions have been dealt with by correspondence.

The Committee, through its Chairman, has also been consulted by the appropriate Government Department regarding restrictions in the use of certain non-ferrous metals by the Gas Industry.

The Draft Code of Practice for the Provision of Services in Buildings, referred to in a note on the Committee's work published in the 2nd Report of the Chairmen's Technical Committee, has now been published as British Standard Code of Practice No. 1043, 1942. A copy of this important Code has been sent to every gas undertaking for information.

Institution Gas Research Fellowship Report

The Institution Gas Research Fellowship Report, 1942 (*Communication No.* 255), by J. E. Garside, Ph.D. (Institution Gas Research Fellow), A. R. Hall, M.Sc. (Smithells Scholar), and D. T. A. Towend, D.Sc., Ph.D., D.I.C. (Livesey Professor), deals with the stability of aerated burner flames.

The research, of which a preliminary account was given in the Institution Gas Research Fellowship Interim Report, 1941, has been further pursued, and recently the technique of instantaneous shadow photography has been developed and applied to it. By this means it has been possible to obtain, for the first time, pictorial records of the phenomena of "light-back" and "blow-off" at intervals of approximately one-fiftieth of a second. It is hoped that further work, using this method, will lead to a much more complete understanding of the mechanism of these phenomena.

Other factors influencing the behaviour of aerated burner flames have also been investigated, including injector action and the effect of the roughness of internal surfaces of burners upon inner cone stability.

The character of the "dead space" between the head of the burner and the base of the flame has also been studied to see how far it may be accounted for not only by a thermal gradient but also by aerodynamical factors. This work has involved the study of the influence of burner profile on the dimensions of "dead space" and any consequent effect of the variations observed upon ignition velocity, "light-back," and "blow-off."

Further numerical data relative to "blow-off" and "light-back" conditions have been obtained with an extended range of gases and burner sizes.

Arthur Duckham Research Fellowship

Work on the luminescence shown by materials in contact with flame has been continued during 1941–42 by the second Arthur Duckham Research Fellow (E. C. W. Smith, B.Sc., Ph.D.). Some attention has been given to the problem of devising a suitable form of mounting for the luminescent material in order to secure the maximum efficiency of light production from the combustion of hydrogen in contact with it. The overall efficiency of light production from the most satisfactory apparatus which has so far been devised has been measured, but is found to be considerably lower than that obtained from the normal incandescent mantle. On the other hand, it has been shown that as the pressure of the atmosphere surrounding the flame is reduced, the efficiency of light production is progressively increased.

The mechanism responsible for the production of the luminescence has been investigated, and it has been shown that the phenomenon can be attributed to the re-combination on the surface of the luminescent material of the hydrogen atoms produced in the flame.

It has also been established that, in the process of re-combination of the hydrogen atoms on such a luminescent surface, almost the whole of the energy released thereby appears as light in the visible region of the spectrum. Further, it would appear that the collisional efficiency of the reaction responsible for the production of the luminescence is very high.

A little more experimental work needs to be carried out before a complete report on this research can be prepared for publication. The work has been temporarily interrupted owing to the fact that Dr. Smith's time has been largely occupied since February, 1942, on some investigations of immediate importance on behalf of a Government Department.

Applications have been made for patent protection in respect of certain matters arising from this work, and Complete Specification No. 17530/40 and Provisional Specification No. 65353/41 have been filed.

The Second Arthur Duckham Research Fellow has supervised a spectrographic examination of certain aspects of the combustion of gas-air mixtures at the surface of incandescent refractory materials successfully completed by R. Long, B.Sc., during the final year of his Honours Degree Course in Gas Engineering at Leeds. This work forms Part I of a thesis which he submitted for the above-mentioned degree, and an account of it will be incorporated when the 3rd Arthur Duckham Fellowship Report is published.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on Jan. 12 at Gas Industry House. Sir David Milne-Watson, Bart., LL.D., D.L., presided.

Sir David reported the great loss which had been sustained by the Board and the Gas Industry in the death of Mr. Stephen Lacey.

The Honour of Knighthood conferred by His Majesty the King on Alderman John E. Daw was reported.

It was reported that Councillor S. J. Perry had been appointed President of the British Commercial Gas Association, and in virtue of this position would become one of the representatives of that Association on the Board.

A report on the general coal position was submitted and discussed.

The evidence given before the Sub-Committee of the Select Committee on National Expenditure by Mr. S. Tagg and Mr. Sholto S. Ogilvie with regard to the position of the Gas Industry was reported.

A letter from the Ministry of Fuel and Power, dated Dec. 24, 1942, announcing an increase in the price of coal of 1s. per ton as from Jan. 1, was discussed, and it was decided that strong representations should be made against these continual increases when the prices of other commodities were being pegged by the Government.

A report was submitted with regard to the Control of Fuel (No. 3) Order, 1942, under which a direction made by the Minister of Fuel and Power gives him power to restrict the use of fuel and to deal with any cases where fuel is being wasted.

The First Interim Report of the No. 3 Sub-Committee of the Post-War Planning Committee on Methods of Charge and Statistics was submitted. It was pointed out that this Interim Report was of a preliminary nature, setting out the lines on which the work was proceeding and giving an indication of some conclusions to which the Committee had come. It was intended to issue further interim reports as each phase of the work was completed. The Board adopted the recommendation of the Post-War Planning Committee whereby a Standing Committee was appointed to deal with this matter with specific terms of reference.

A discussion took place with regard to the necessity for the installation of gas in all housing estates which were now being erected or planned, and a report was submitted with regard to the steps which were being taken by the Council towards this end.

Matters with regard to Orders promoted by gas companies and Public Bills were discussed and decisions given as to the action to be taken by the Council.

The resignation of Mr. W. J. A. Butterfield as Vice-Chairman and Honorary Treasurer of the National Illumination Committee was reported, and the steps which were being taken to fill the various vacancies on the Committee which would ensue were approved.

The next meeting of the Board will be held on Tuesday, Feb. 9.

At a Meeting of the Town and Country Planning Association at 1.15 p.m. on March 18, Mr. H. W. Healy will give a talk on "Industry and Planning," which will be followed by a discussion. The meeting will be held at the Central Building, Y.W.C.A., Great Russell Street, W.C. 2.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

Gas Products Prices

The London Market Jan. 18.

The chief item of interest in connexion with the Coal Tar Products market is the issue of a new Government Order, the Coal Tar Products Prices Order, 1942 (S. R. & O., 1942, No. 2509), which came into force on Jan. 1.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

The Provinces Jan. 18.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 10d., pure, 2s. 5d. (controlled by the Control of Toluene No. 2 Order, July 3, 1941, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 1s. to 1s. 4d. according to quality. Solvent naphtha, naked, North, 2s. 2d. to 2s. 6d. Heavy naphtha, North, 1s. 10d. to 1s. 11d. Carbolic acid, 60's, controlled by the Coal Tar Acids Prices (Inland) Order, 1942, operative from May 1. Naphthalene, controlled by the Naphthalene prices (Inland) Order, 1942, dated April 15, 1942, and operative from May 1, 1942, £19 to £19 10s.—bags free. Anthracene, controlled by the Anthracene Prices (Inland) Order, 1942, operative from May 1. Filtered heavy oil (min. gr. 1,080), 7½d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5½d; timber preservation and other purposes 4¾d. to 6d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland Jan. 16.

Market continues active with prices unchanged. Refined tar controlled. Value is 4½d. per gallon *ex* Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7¼d. to 7½d.; neutral oil, 6¾d. to 7d. per gallon; all *ex* Works in bulk. Refined cresylic acid is in good call at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha: 6½d. to 7d. per gallon. Solvent naphtha: Basic prices delivered in 1,000 gallon lots, 90/160 grade, 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d., Rectified, 2s. 3d. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

Gas Stocks and Shares

Except in a few sections business was not particularly active on the Stock Exchange last week, but the general tone was firm throughout. Some good features appeared in the industrial market. Similar conditions prevailed in the Gas Market, and although the volume of business was not above normal, it only required a transaction or enquiry to harden prices. The effect of this can be seen in the list below, which contains more gains in quotations than for some time past. A satisfactory feature is the renewed strength of those companies operating in India, Bombay rising to 22s. and Oriental closing 10 points higher at 97½. Among the home companies British ordinary and Mid-Southern Utility "C" both gained 5 points. The following is a complete list of price changes during the week:

OFFICIAL LIST

Alliance & Dublin Ord.	105—115	+4½
Associated Gas & Water 4 p.c. Cum. Pref.	14/9—15/9	+–/6d.
Bombay	21/6—22/6	+1/6
Bournemouth max.	137—142	+2
British Ord.	87—92	+5
Commercial 5 p.c. Deb.	100—105	+3
Gas Consolidation "B" Ord. ...	16/6—17/6	+–/6d.
Ditto 4 p.c. 1st Red. Pref.	18/—20/–	+–/6d.

OFFICIAL LIST—*continued.*

Gas Light Units	17/3—18/3	+–/6d.
Ditto 3½ p.c. max.	63—67	+1
Ditto 4 p.c. Pref.	79—84	+1
Ditto 3 p.c. Deb.	84—87	+1
Imperial Continental Ord.	78—83	+1
Mid-Southern "C"	82—87	+5
Oriental	95—100	+10
South-Eastern Gas Corporation Ord.	16/6—17/6	+–/3d.
South Metropolitan 6 p.c. Pref. ...	89—94	+1
Ditto 5 p.c. Red. Deb. (*x.d.*) ...	102—107	Jan. 11
South Suburban Ord.	85—90	+1
Ditto 5 p.c. Deb.	120—125	+5
Tottenham Ord.	97—102	+2
Ditto 5 p.c. Pref.	97—102	+2
United Kingdom Gas Corporation Ord.	19/3—20/3	+–/3d.
Wandsworth Cons.	85—90	+1
Watford & St. Albans Ord.	98—103	+1
Ditto 3½ p.c. Red. Deb.	90—95	+6

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